Enamel Pits of the Lazaret Man: developmental defects

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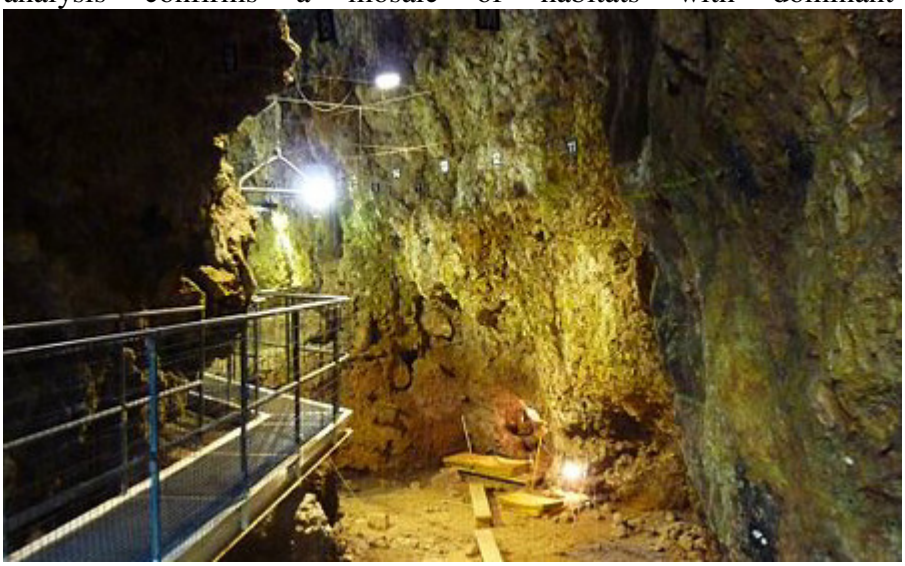
The cave of Lazaret (South of France) was perched in the Boron Mount at 110 meters above the sea level 130 - 170.000 years ago when the "Lazaret Man" occupied its floor surrounded by seaweed. It was during a cold and wet period, 180/200 ka BP. Fossil human bones recovered include the skull of a nine-year old child with meningioma, deciduous teeth and a lower canine from a young adult. Early type of human, either homo heidelbergensis or a proto-Neanderthal, produced more than 20,000 bone fragments from the remains of animals. Fauna consists of hunted species living in grassland interspersed with woodland. Pollen analysis confirms a mosaic of habitats with dominant open environments.



Fouilles en cours à l'intérieur de la grotte du Lazaret. Nice, France, Miniwark, 24 mai 2010

The skull and tooth morphology can be discussed because many fossils among homo heidelbergensis 450 000 – 100 000 years BP, like Tautavel (France), Petralona (Greece), (Steinheim Germany) or Saccopastore (Italy), evolved gradually towards Neanderthal. These are considered as «proto-Neanderthals" because of the progressive installation of this very special morphology for this period. For example, Tautavel Man (from Arago cave) has a very large, high and wide face with an expanded anterior dentition and a swollen infraorbital region without the characteristic *Homo* depression called "canine fossa" that is also absent in Neanderthal. Further more, the dental characters of Tautavel man announce Neanderthal.

The full suite of Neanderthal features appeared with the ''classic'' Neanderthals, in the Late Pleistocene, dated from approximately 70 to 30 ka.

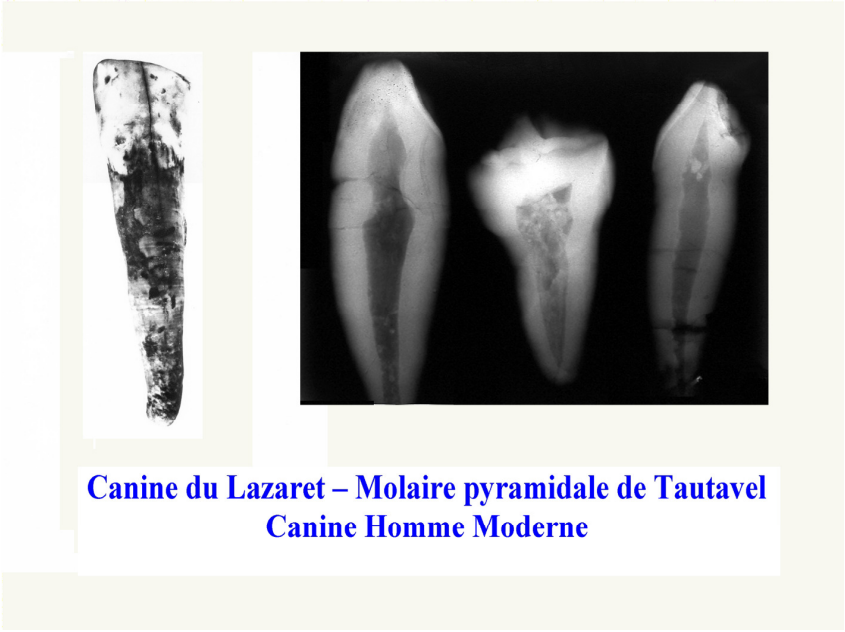
Neanderthal dental morphology first descriptions focused on the morphology of the teeth, thinner enamel, taurodontism and pyramidal molar. All features highly variable in Neanderthal and present in delimited conditions in Homo sapiens.

The particular morphology concerns all types of teeth:

-The upper incisors are large and shovel-like with marked lingual tubercles;
-All frontal teeth present an increase of the labio-lingual diameter.
-The upper canines show a moderate degree of shovelling.
-The lower canine tends to reflect the incisive morphology.

-Enlargement of the pulp cavity in the postcanine teeth enlarge the roots, giving a 'bull' aspect to the tooth named Taurodontism. The pulp chamber are enlarged vertically, consequently the furcation is moved down the root. Single rooted molars are by consequence pyramidal in shape.
-The upper premolar occlusal surfaces are complex with additional cusps.
-The first lower premolar display a transverse crest connecting the buccal and the lingual cusps.
-The lower second premolar has a strong transverse crest.

Taurodontism is considered as an aberrant dental morphology in modern man. It can be found in primary and permanent dentition and need to be considered particularly with respect to treatment. In some cases it follows an autosomal dominant type of inheritance. This condition is found in association with amelogenesis imperfecta, ectodermal dysplasia and **tricho-dento-osseous syndrome** with enamel defects.



Canine du Lazaret – Molaire pyramidale de Tautavel
Canine Homme Moderne

External enamel surface defects are common clinical phenomena. Their appearances are varied in nature and position. Different types can be observed:
-Enamel hypoplasias appearing in the form of pits, horizontal lines or grooves and localized outcrops;
-Enamel hypomineralization that can produce:
.opacities, which are changes in translucency with white or yellow areas on or below the surface;
.soft, discoloured and rugged surface;
.amelogenesis imperfecta, genomic in origin, affect the structure of enamel of all or nearly all the teeth in a more or less equal manner giving abnormal color: yellow, brown or grey. It may be associated with morphologic or biochemical changes elsewhere in the body.

Defects are used as an indicator of the health status of human populations. Because physical anthropology applications have involved documenting an increase in the prevalence of hypoplasia pits and lines in subsistence systems of various ages (Skinner M.F., 1986), the present report describes hypoplasia pits of the Lazaret man

The teeth examined consist of the adult lower right canine and a deciduous upper left incisor. The replica method using nitrocellulose varnish permitted microscopic analysis in different magnification as it can be seen on the figure 2.

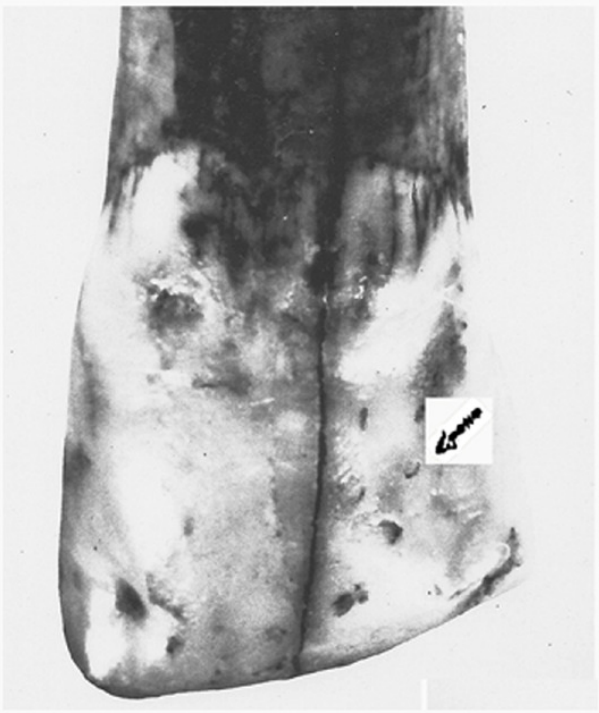
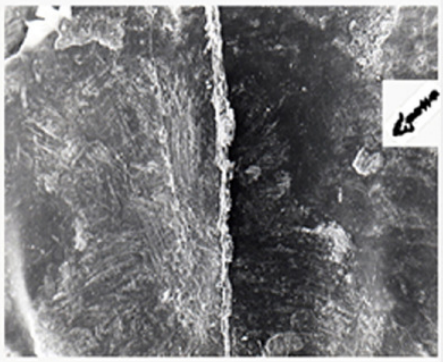
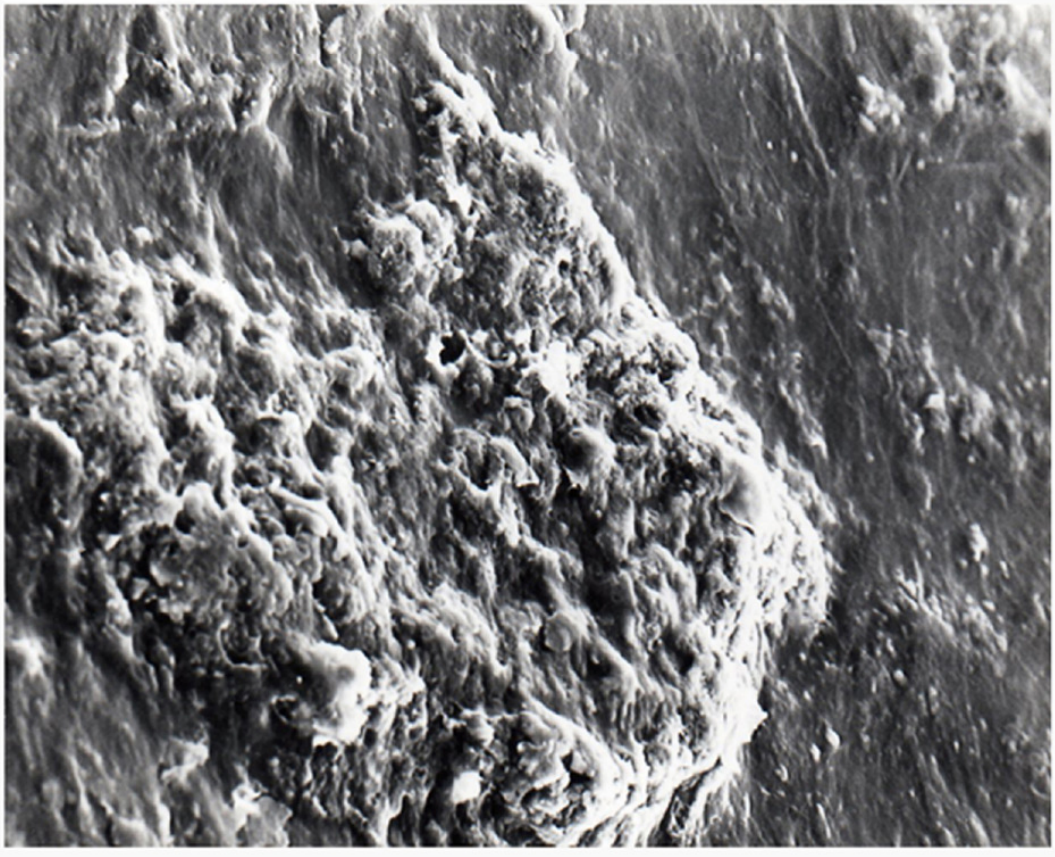


fig. 2 **Enamel Pits of the Lazaret Man**
adult lower right canine



face vestibulaire de la canine 1cm = 0,3 mm



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Enamel Pits of the Lazaret Man

The human remains found at the Lazaret cave consist of two teeth and one parietal bone. Microscopic analysis of the dental enamel surfaces revealed various forms of minor hypoplasia distributed over the whole surface of the crowns: micro and macro-pits, craters and linear grooves.

Research into the history of dental disorders during the course of human evolution has suggested that these increase in association with the use of cultivated foods. In a previous study we have shown that dental decay develops initially as faults in the outer surface of the enamel (Puech, 1977), this process is studied further using the association of structural alterations in the dental enamel surface of the two Pre-Neanderthal men at the cave of Le Lazaret.

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1. Introduction

The Lazaret site is located near Nice (France), on the edge of the Mediterranean. The hominid remains are over 120,000 years old, pre-dating the Neanderthalians. During this period man spread widely over the earth, adapting to a range of new environments. The analysis of fossil European hominids show parallel development of several different groups (Lumley & Piveteau, 1969), and the analysis of dental enamel surfaces is of particular interest in this context.

The Lazaret teeth were found at different levels in the same archaeological layer excavated over 1953 and 1958. The layer dates from Riss III.

The teeth consist of an adult lower right canine and a deciduous upper left incisor. The incisor seems to be that of a child about two years old (Plate 1 and Table 1).

Table 1

Deciduous upper left incisor	Lazaret	Neanderthal	Actual
M–D	7·7	7·3	6·5
B–L	6·2	6·2	5
Rob. index	47·74	45·26	32·5

The canine was found associated with an Acheulean lithic industry. The tooth has horizontal wear over about 2–3 mm along the free edge (Plate 2), and X-ray analysis shows a large pulp cavity (Table 2).

2. Method

The replica method is the only one known to us which permits microscopic analysis of the dental surfaces when the tooth is not to be placed in vacuum (Pedersen & Scott, 1951). We prefer to use nitrocellulose varnish since this allows a replica to be made by covering the tooth with a thin layer of resin. This layer is peeled off after setting. The resin solvent

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Table 2

Lower canine	Lazaret	Mauer	Neanderthal	Actual
M–D	8·3	7·6	7·5	6–7·2
B–L	9·4	9	7·5	6·8–9
Crown lower	9	—	—	9·4–13·5
Root lower	21	—	—	11–21
Total lower	30	—	—	25·6
Rob. index	78·02	68·4	56·3	55·1

de Lumley & Piveteau (1969).

is acetone, which is frequently used by prehistorians. The replica is easily transported and may be examined directly with a transmitted light microscope, or a positive print may be obtained by casting the replica in resin and gold-coating the resulting model for examination with the scanning electron microscope.

3. Results

At a × 300 magnification the structure of the enamel is seen to consist of prisms separated by an interprismatic substance. Analysis with a scanning microscope must be done after etching the surface with acid. This reveals a difference in orientation between the prisms and the interprismatic substance, and a space called the prism sheath. The extremities of the prisms may be bent towards the surface, but equally, may have a sharp curvature giving a smooth surface (Gustafson, 1962). These differences give a variety of prism and explain why observation reveals wave-like smooth and rough bands forming hollows and crests, concentric with the neck of the tooth, the latter being formed by the extremities of the prisms [Plate 3, (1)]. These waves are called perikymata. They are closer together in the cervical zone with a more or less regular direction [Plate 3, (2)] each wave being located between two striae of Retzius.

Pronounced hollows indicate hypoplasia [Plate 3, (2) and (3)]. Gustafson (1962) studied the roughened zones of the enamel surfaces by analyzing longitudinal sections under polarized light. These zones are dotted with crater-like structures represented by small and large pits, smooth, and aprismatic. These defects are of limited extent and form the subject of this study, which does not consider larger scale alterations, also called hypoplasias, which may result in the complete absence of the superficial enamel layer.

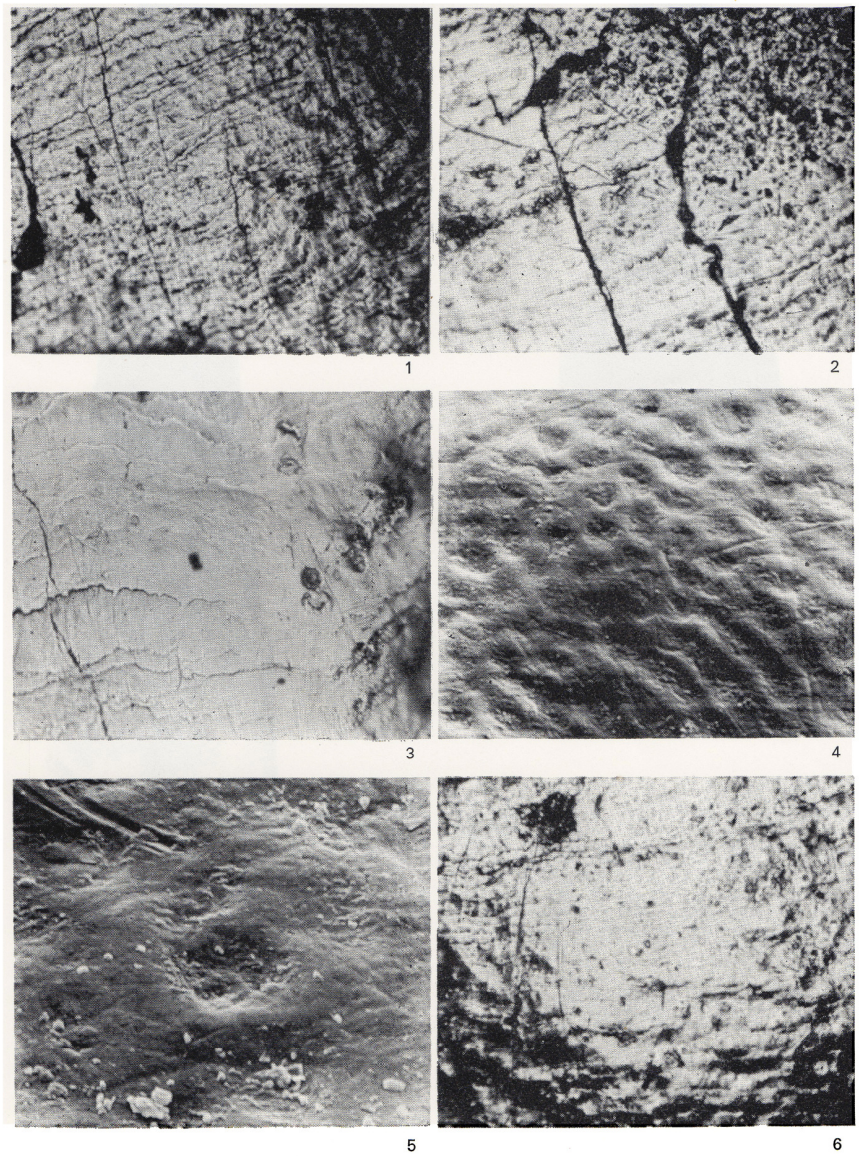
Most of these minor defects result from accentuation of the perikymata. The prisms have a larger curvature, and the compressed sections are shortened. One consequence of this compression is the approximation of the striae of Retzius. If the striae converge at one point a pit is formed [Plate 3, (3)]. In the scanning microscope it is possible to see a thin layer covering the enamel surface like an envelope, and the hypoplastic areas seem at first sight to represent a loss of this. However thin sections show that on the contrary they result from localized condensation with an altered orientation of the prisms.

The irregular perikymata seen on the Lazaret canine have a "saw-tooth" aspect with, in places, a joining of the extremities of the "teeth" forming pits [Plate 3, (1)]. The micropits are oval, 20–30 μm in diameter on average, and appear either as depressions or as small craters with an irregular central cavity [Plate 3, (5)]. The bottoms of these craters appear granular at high magnification, probably corresponding to the extremities of the prisms. This indicates a deficiency in the superficial layer of the enamel which in its

Plate 1. The Lazaret deciduous upper left incisor.

Plate 2. The Lazaret adult lower right canine.

Plate 3. Macro and microscopic surface defects of the teeth of the Lazaret man. (1) The canine: perikymata on the surface, waves like smooth and rough bands (×50). (2) The deciduous incisor; more or less regular direction of the perikymata, the deficiency starts in the hollow of the perikymata (×50). (3) Microscopic appearance of macro-pit on the replica of the canine surface (×200). (4) Enamel typical rod ends with honeycomb appearance given by depressions which are shallow (×2000). (5) Pit appearing as a depression with an irregular central cavity (×800). (6) Deficiency in the superficial layer with pits and grooves over the whole dental crown (canine) of the Lazaret; grooves appear as rolling elevations (×50).



1 2 3 4 5 6

minimal form gives rise to micro-pits, but can result in macro-pits and grooves [Plate 3, (3) and (6)]. This deficiency starts in the hollow of the perikymata where the irregular surface obscures the natural honey comb formation [Plate 3, (2) and (3)], in contrast to the eroded zones where it is very marked. These features appear in varying degrees over the whole of the dental crowns of the Lazaret specimens [Plate 3, (2) and (6)].

4. Discussion

Certain dental characteristics are hereditary and may appear in particular populations forming a basis for statistical phylogenetic studies. However, this is unlikely to be the case with the microscopic features of the dental surfaces. In fact, the structure and mineralization of the enamel, or of the dentine, are under the influence of numerous factors during their formation, the ameloblasts reacting to environmental factors. The external structure of the enamel is in direct relationship with underlying layers (Gustafson, 1962), and provides evidence of changes in this environment.

This is a generalized susceptibility since the minor hypoplasia, analyzed here in the case of the Lazaret specimens, are present with varying degrees of incidence in all human populations that we have studied i.e., *Australopithecus* (Prof. P. O. Pedersen replica collection in Copenhagen), *Homo erectus* from China (*Sinanthropus* from the collection of Prof. Zdansky and Prof. von Koenigswald at Uppsala and Frankfurt), from Europe (*Heidelbergensis*: Prof. Kraatz; *Tautavelensis:* Prof. de Lumley, Atapuerca men: Prof. Aguirre), *Homo sapiens neandertalensis* (La Ferrassie: Prof. Coppens; Hortus: Prof. de Lumley) and *Homo sapiens sapiens* (Peyraoutes: Prof. Bouville).

In 1951 Pedersen & Scott examined the teeth of 100 Eskimo skulls 100–300 years old, 189 teeth extracted from indigenous western Greenlanders, and some 565 teeth from North American White patients (Washington). They found a marked resemblance between the nature and distribution of the perikymata on the dental surfaces of the Eskimo and the Greenlanders on the one hand, and the North American Whites on the other. However, their general form differs in that the Arctic populations have irregular perikymata, whilse those of the American Whites are more regular. Irregular perikymata are not seen in the canine teeth of the American Whites (one of the teeth from Lazaret is a canine). The micro-pits observed in all three populations are located in the cervical zone, particularly on the molar teeth; only the Alaskan Eskimos have them also over the central parts of the dental surfaces. For Sarnat & Schour (1941) two thirds of modern samples have hypoplasia in the cuspid half of the canine, while in the prehistoric samples the hypoplasia are mainly in the cervical zone.

These defects may be explained by a quantitative reduction in the deposition of the enamel matrix during amelogenesis (Sarnat & Schour, 1941). Enamel formation begins in the third month of intra-uterine life and continues up to the tenth year for permanent teeth. It takes place progressively from the summit to the base of the teeth as layered deposits giving rise to the striae of Retzius. Metabolic disturbance at any time may slow down or stop this process resulting in structural disturbances.

The most affected zones of the Lazaret teeth are easily seen by microscopical analysis, but these do not form a horizontal band, forming instead a generalised mass of pits. Under the microscope pits may be seen involving the whole of the coronal surface.

These alterations are classically considered to be due to nutritional deficiencies, infectious diseases, or abnormal pregnancy (Molnar & Ward, 1975).

It remains to be found how these features are produced and a possible correlation between the microscopic state of the enamel surface and episodic stress. Is there a cultural improvement which have led to the increase of such features?

These explanations may be accepted for the defects but caution is required in making a connection between a disease and a lesion. Several papers cover the synthesis of works done on influence of environment and food which brings reactions according to individual, family and population (Ferembach, 1978).

Hypoplasia does not only exist in the form of local irregularities, but also as small pits of irregular diameter over the whole surface of the teeth. This suggests a structural abnormality in the individual, and the fact that there are less defects today may correlate with a reduction in infant diseases, particularly those of gastro-intestinal type.

It is not possible to assess the state of health of the Lazaret hominid population since the fragmentary remains are not a representative sample. However, no other human remains were found on the site apart from the infant parietal bone on which there is a major lesion which suggests a meningioma (Lumley & Piveteau, 1969). Human behavior may explain this grouping or selection of the sample, perhaps through abandonment or death at the site of weak individuals during the migratory movements of the group.

5. Conclusion

The pits and micro-pits on the dental enamel of Lazaret man may result from continual disturbance over a long period, rather than episodic disturbance. Microscopic analysis does not allow us to distinguish the boundary between the normal characteristics of the external enamel surfaces and those which might be classed as pathological. The Lazaret hominids were nomads, living under cold, wet, climatic conditions. The climate corresponds with that found today above 1000 m in the same area of southern France (Lumley, 1973). It is probable that the extreme robustness of the hominids allowed most of them to overcome the difficulties of a primitive life without any other consequences to their health than those which we have described.

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